FM SYSTEM GUIDE

For the ***TEMPO+ Speech Processor***

MED-EL
MEDICAL ELECTRONICS

TABLE OF CONTENTS

INTRODUCTION TO FM SYSTEMS 4

ABOUT DIFFICULT LISTENING ENVIRONMENTS 5

USING FM SYSTEMS IN DIFFICULT LISTENING ENVIRONMENTS 6

HOW OFTEN SHOULD FM SYSTEMS BE USED? 9

CONNECTING AN FM SYSTEM TO THE TEMPO+ SPEECH PROCESSOR 10

:: FM Adapter Cables for the TEMPO+ Angled Battery Pack 12

:: Connection to the TEMPO+ Angled Battery Pack 13

:: FM Adapter Cables for the TEMPO+ Remote Battery Pack 14

:: Connection to the TEMPO+ Remote Battery Pack 15

RECOMMENDED FM SYSTEMS AND SETTINGS 17

:: Phonic Ear Lexis and MicroLink CI S Adapter 18

:: Phonic Ear Solaris PE 571T + PE 572R (or PE 575 R) 20

:: Campus S, Phonak MicroLink MLxS and MicroLink CI S Adapter 22

:: Campus S and Phonak MicroLink CI+ 24

:: Tx3 HandyMic and Phonak MicroLink CI+ 26

:: Phonak MicroVox H33 COM I 28

:: Sennheiser mikroport 2015 30

:: Sennheiser mikroport 2013 PLL 32

:: Research Vario 800 34

:: Connevans CRM 220 D 36

:: Sonovation Logicom Ci (Remote Battery Pack only) 38

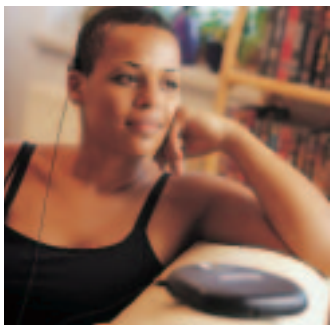
:: Williams Sound Hearing Helper PFM 350 40

:: Comtek AT 216 42

TROUBLESHOOTING 44

REFERENCES 46

Introduction to FM systems

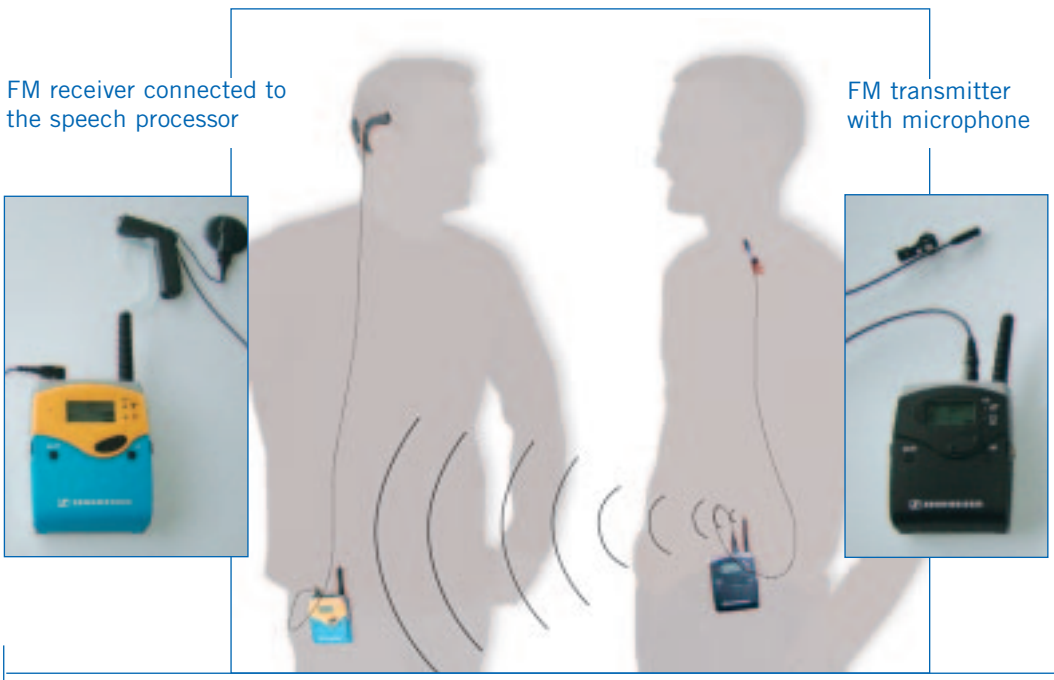


MED-EL offers a wide range of adapter cables for use with frequency modulated systems (FM systems), battery-operated devices such as portable CD players, and assistive listening devices (ALD). The TEMPO+ speech processor can be connected to these devices using either the Angled Battery Pack or the Remote Battery Pack.

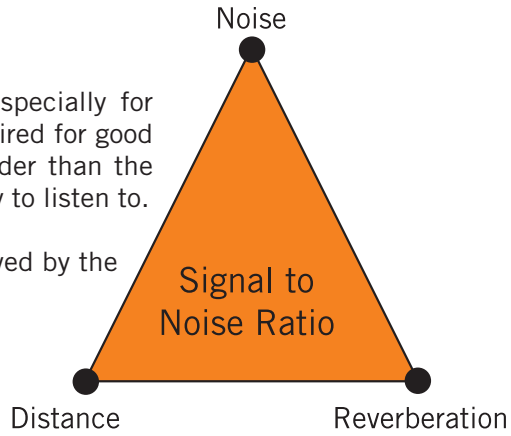
This guide, intended for MED-EL recipients, teachers, technical personnel and audiologists, presents an overview of compatible FM systems, information on connection and recommended settings.

An FM system consists of two basic components: an FM transmitter with a microphone and an FM receiver. For optimal benefit, the microphone should be positioned close to the speaker, e.g. teacher. Due to the close position of the microphone to the sound source, background noise and reverberated sounds are greatly reduced.

The FM transmitter amplifies and modulates the sound signal and sends it to the FM receiver via radio wave. The FM receiver demodulates the signal and transmits it to the speech processor (see fig. 1). For the CI recipient, the sound quality is the same as if the person were speaking directly into the speech processor's microphone.



About difficult listening environments



Background noise makes hearing more difficult for everyone – and especially for people with hearing impairment. An optimal signal to noise ratio is required for good listening conditions. The signal (e.g. speech) should be somewhat louder than the background noise (e.g. traffic, people talking, etc.) to be considered easy to listen to.

There are three factors that degrade the quality of a speech signal received by the microphone of the speech processor: noise, reverberation and distance.

Noise such as the radio or television playing in the background, scraping of chairs, street sounds, people talking, rustling paper, air conditioners, fans and other sounds all affect our ability to hear and understand speech. To improve hearing in such conditions, it is important to ensure that speech is presented at a louder level than any competing background noise. For most normal hearing individuals, the signal should be 6 dB louder than the noise, while for hearing impaired individuals it should be 15 to 18 dB louder. The average classroom has a signal to noise ratio of 0 dB.

Reverberation or echo is a prolongation of sound - due to multiple reflections from hard surfaces - that affects the clearness of speech. The degree of reverberation (measured as the time required for a sound to drop 60 dB from its initial level) is dependent on the characteristics of a room: hard walls, high ceilings, tiled floors and glass windows all contribute to a more reverberant room. Thus, problems with listening occur more frequently in classrooms, the bathroom, kitchen, the laundry room or the cellar. For effective listening, hearing impaired people need rooms to have a reverberation of no more than 0.3-0.4 seconds – the average classroom reverberation level is twice as high.

Distance is the range in which speech can be heard. With hearing loss, this range is reduced, so the listener needs to be closer to the speaker to hear speech well. The best distance for hearing speech is 1-2 m (3-6 ft.). Doubling this distance reduces the signal to noise ratio by 6 dB.

What can be done to improve hearing in difficult listening conditions?

FM systems work by placing the speech signal right at the listener's ear, thus reducing the effects of background noise, echo and distance. First, FM systems cut down noise by amplifying the speaker's voice. They also reduce the effects of distance by bringing the speaker's voice directly to the listener's ear. Finally, FM systems dampen echo by making the speech signal clearer. By using radio waves, FM systems allow the strength and quality of sounds to remain constant over the operational distance.

FM systems also reduce the effort required for communication. By improving the signal to noise ratio, reducing distance and echo, they reduce listening fatigue. The communication process is also easier for the speaker, as he or she can move around freely and talk at normal levels - no loudspeakers or other devices are required.

An effective solution for the poor acoustic environments in classrooms is the use of FM systems. FM systems use frequency-modulated (FM) radio waves to transmit the speech signal from the teacher directly to the student's speech processor.

Using FM systems in difficult listening environments

Ideally, FM systems should be used in difficult or complex listening situations. A listening situation is considered difficult when (1) the signal (e.g. a teacher's voice) is very far away from the listener, (2) the background noise is very loud and additional sounds make it difficult to hear the signal (e.g. in a classroom), or (3) in reverberant rooms where the echo distorts the signal (e.g. in auditoriums).

Indoor listening environments

At home, rooms such as the kitchen, bathroom, hallway, laundry, basement, etc. are characterized by particularly high reverberation levels due to the sparse use of sound-reducing materials such as carpets, curtains, etc. Large, smooth surfaces lead to multiple reflections of sound waves. A table without a tablecloth, therefore, may also create a difficult listening situation for a hearing-impaired individual by reflecting sound. A golden rule for improving listening situations is to use as many sound-reducing materials as possible in all rooms. Background noise is another condition in the home that can adversely affect a listening environment. Sounds from a radio, for example, may complicate a listening situation and should be turned off when possible. When background noise is unavoidable in the home, an FM system can be of considerable benefit.

Group situations, restaurants, etc.

In group situations, background noise is considerably louder than in individual conversations. Low level conversation, laughter, scraping of chairs and clinking of dishes all add noise to the environment. An FM system can be of assistance in this situation as the listener can position the FM microphone near the desired sound source, thereby enhancing the signal and effectively reducing the effect of background noise.

Many listeners have great difficulty hearing speech in restaurants where there is a great deal of background noise. Some solutions include placing the FM microphone on the speaker's collar or hanging it from a light fixture above the table. Group members should be aware of the difficulties such environments impose on a person with a hearing loss, and limit the conversation to one speaker at a time.

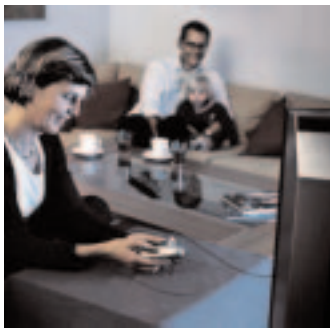
Celebrations, parties

Noise levels at parties and other celebrations are usually very high. Music, conversation and laughter are often so loud that even normally hearing people have to raise their voices in order to be heard. As this happens, background noise levels increase further. Speaking directly into the microphone of the FM system is very helpful in such situations.

Another tool ideal for such difficult environments is the TeleMic system. The integrated external microphone allows the TeleMic to be used as a "tie-clip"

microphone, providing effective assistance in difficult listening situations, such as conversations in loud background noise.

Television, listening to music



To reduce ambient noise when watching television, the microphone should be placed directly in front of the TV loudspeaker or music source. As an additional benefit, the volume of the device can be turned down so that others are not disturbed.

Most FM transmitters are equipped with an external audio input (AUX) for direct connection of the TV or radio to the FM system. While using, the direct input sound signals are transferred directly to the speech processor. By using the EXT or MIX listening mode the listener can choose whether or not to suppress background noise.

We recommend using the SCART output socket (on the back of the TV) instead of the headphone output for direct connection to FM systems. This allows others to listen to the TV loudspeaker, whereas a connection via the headphone output suppresses the loudspeaker.

School

Listening situations in school can be very demanding and exhausting for hearing-impaired children, affecting their learning abilities and auditory, speech and language development. Social interactions may also suffer from misunderstood messages or missed acoustic information.

Noise levels of 65–90dB are often measured in schools - particularly in schools where the furnishings and size of the classroom are not designed to support hearing-impaired children.

Three basic listening situations can be identified in schools:

:: Free play or working freely in a group: these situations are characterized by a babble of voices and background noise as well as a large or variable distance from the teacher. In this case, if the teacher wears the microphone of the FM system, the hearing-impaired child can hear the teacher's instructions directly, despite the high level of interfering noise.

:: Group work in smaller groups: in this situation, a hearing-impaired child should be able to understand all members of the group to actively participate in the discussion or project. Most benefit can be obtained from an FM system when the speaker speaks directly into the microphone. This allows the hearing-impaired child to follow the conversation without great effort. Speech understanding is also facilitated by placing the microphone in the center of the group.

:: Teacher's instructions, dictations, working in a large group: these are the most common situations in schools. It is important for a child to be able to completely understand and concentrate on the teacher's instructions over a longer period of time. An FM system enhances the teacher's voice, thus improving the signal-to-noise ratio. As a result, less effort is required for a hearing-impaired child to follow spoken instructions.

Cars

To overcome listening difficulties caused by engine noise and traffic, the microphone may be clipped to the front or back seat if there are several passengers, or to the collar of the speaker if there is only one other person in the car. The same can be done using the microphone mode of the TeleMic system.

Meetings

Business meetings often take place at large tables, and listeners may have trouble with echo, noise and not being able to see the speaker's face. It is often helpful to position the microphone at the center of the table or in front of the main speaker.

Large rooms

Listening in large rooms, e.g. auditoriums, churches or other reverberant rooms, can cause problems, particularly due to echo and distance. Difficulties can be overcome by placing the microphone of the FM system at the loud speaker amplifying the desired sound. It is advisable to ask permission from the speaker prior to the event.

In many public areas, such as cinemas, theaters, museums, etc., assistive listening devices are already available. If so, it is advisable to use these systems for better hearing abilities.

The TeleMic is an ideal accessory for the TEMPO+ speech processor where inductive loop systems are available. The built in telecoil allows easy wireless access to room-sized induction loops which are often available in such areas.

Outdoor listening environments

Playgrounds, schoolyards, outdoor activities such as riding a bike or horse, jogging, etc. all are characterized by ambient noise and, particularly, by the speaker's distance from the listener. It is almost impossible for a hearing-impaired individual to hear a call from a distance of 10-20 m (30-60 ft.). The FM system can be used to compensate this distance. FM systems transmit sounds and speech over such distances directly to the listener.

How often should FM systems be used?

Childrens' ability to hear their parents is very important, especially for young children. Warnings and instructions can be conveyed to the child over a distance to increase the child's safety. However, FM systems should not be used constantly. First, specific measures to improve room acoustics (no avoidable background noise, sound absorbing materials, etc.) and communication (only one speaker, speaking clearly, minimizing the distance to the listener, etc.) should be taken. Hearing-impaired children should be taught coping strategies to help them deal with various complex listening situations. They should learn to decide for themselves when to use the FM system. In addition, it may not always be possible to use an FM system (e.g. if the equipment is not available), so hearing-impaired persons should be able to use other auditory assistance techniques in these cases as alternatives to FM systems.

The FM system should be used when the hearing-impaired individual wants to understand acoustic information completely and reliably over a longer period of time. This is easiest with only one speaker, e.g. a teacher or instructor, without a discussion involving several people. In group conversations, it is best to have the speaker speak directly into the microphone. Since this may not always be possible, it is important to enhance the signal of the main speaker in group situations such as classroom discussions, where the contributions of classmates should not be completely masked.

Connecting an FM system to the TEMPO+ speech processor

NOTE:
Adapter cables should never be used to connect the TEMPO+ to equipment that is powered via direct connection to an electrical outlet.

To connect an FM receiver to the TEMPO+ speech processor, an adapter cable is required. This cable not only transfers the signal to the speech processor, but also adapts the output level of the FM receiver to the input level of the speech processor. Furthermore, the adapter cable functions as an antenna for some FM receivers. Therefore, it is important to use the correct adapter cable to connect a specific FM device to the speech processor.

Direct input / MIX and EXT mode

When an FM system is connected to the TEMPO+ speech processor, the user hears the input from both the TEMPO+ microphone and the FM system microphone. The sound received by the microphone of the TEMPO+ will be slightly softer compared to the normal listening situation in order to give priority to the sound from the FM system. This mode is called MIX mode and is advisable for most listing situations.

Should a situation require listening to an external device without disturbing background noise, the EXT mode is available. In EXT mode, the TEMPO+ microphone is deactivated, and only the signal of the external device is sent to the TEMPO+ speech processor.

MIX/EXT mode for the Angled Battery Pack

When using the TEMPO+ Angled Battery Pack for external input, the MIX and EXT functions are selected by using the appropriate adapter cable or by using the sensitivity control of the TEMPO+ microphone.

MED-EL recommends that FM systems set up with the Angled Battery Pack be used with MIX cables. This is particularly advisable for classroom situations.

If a situation should require listening to an external source alone, the EXT mode can be reached by turning the sensitivity control of the TEMPO+ speech processor to the OFF position. Please refer to the chapter “Influence of the TEMPO+ sensitivity control” for more details.

MIX/EXT mode for the Remote Battery Pack

When using the Remote Battery Pack, the MIX and EXT functions are selected by the EXT/MIX switch.

Influence of the TEMPO+ sensitivity control

The sensitivity control of the TEMPO+ speech processor enables the user to control the processing of desired sounds and background noise. When using FM systems, the effect of background noise and reverberation is minimized. FM systems help to reduce background noise while enhancing and stabilizing the main sound source.

In MIX mode, the listener hears environmental sounds received by the TEMPO+ microphone plus the signal from the external source (FM system). If a hearing situation requires concentrating only on the signal coming from the external source, hearing can be optimized by deactivating the TEMPO+ microphone. This is performed by turning the sensitivity control to the OFF position.

The TEMPO+ sensitivity control influences the inputs from the TEMPO+ microphone and the external source as follows:

Sensitivity OFF	TEMPO+ microphone effectively disabled. User hears only the external source, situation comparable with EXT mode.	
Sensitivity Medium normal setting	Sensitivity of normal user setting, user hears mix of TEMPO+ microphone and external source.	

Binaural adapter cable

The bilateral adapter cable allows the connection of two TEMPO+ speech processors to one FM system. The microphones of both TEMPO+ processors remain active. The user hears both the input from the external source as well as environmental sounds. Bilateral adapter cables are available for the Angled Battery Pack and nearly all recommended FM systems.

FM Adapter Cables for the TEMPO+ Angled Battery Pack

MED-EL offers a variety of adapter cables for use with FM systems, battery-operated devices such as portable CD players, and Assistive Listening Devices (ALDs).

FM Systems generally require adapter cables designed for each specific system. The following table provides a list of FM Systems and compatible adapter cables.

Manufacturer	Type	FM System Name	Adapter Cable	Order No.
Phonic Ear	Transmitter	Lexis		
Phonic Ear	Receiver	Lexis		
Phonak	Adapter	MicroLink CI S	Phonak Red Cable (Mix)	from Phonak
			Phonak Red Red Cable (BiMix)	from Phonak
Phonic Ear	Transmitter & Receiver	Solaris	T+ EuroMix (3 pins)	02379
			T+ EuroBiMix (3 pins)	02707
Phonak	Transmitter	Campus S		
Phonak	Receiver	MicroLink MLxS		
Phonak	Adapter	MicroLink CI S	Phonak Red Cable (Mix)	from Phonak
			Phonak Red Red Cable (BiMix)	from Phonak
Phonak	Transmitter	Campus S		
Phonak	Receiver	MicroLink CI+	Phonak Red Cable (Mix)	from Phonak
			Phonak Red Red Cable (BiMix)	from Phonak
Phonak	Transmitter	HandyMic		
Phonak	Receiver	MicroLink CI+	Phonak Red Cable (Mix)	from Phonak
			Phonak Red Red Cable (BiMix)	from Phonak
Phonak	Transmitter & Receiver	MicroVox Hxx COM I	T+ EuroMix (3 pins)	02379
			T+ EuroBiMix (3 pins)	02707
Sennheiser	Transmitter & Receiver	Mikroport 2015	T+ AudioMix (yellow ring)	02377
			T+ Audio BiMix (yellow ring)	02383
Sennheiser	Transmitter & Receiver	Mikroport 2013 PLL	T+ AudioMix (yellow ring)	02377
			T+ Audio BiMix (yellow ring)	02383
			T+ AudioExt (red ring)	02378
Research	Transmitter & Receiver	Vario 800	Vario 800Mix Cable	03078
Connevans	Transmitter & Receiver	CRM 220	T+ ConnevansMix (2 pins)	02381
Williams Sound	Transmitter & Receiver	Hearing Helper	T+ AudioMix (yellow ring)	02377
			T+ AudioExt (red ring)	02378
Comtek	Transmitter & Receiver	Comtek AT 216	Comtek Mix Cable	03080

NOTE:

Mix cable - TEMPO+ microphone remains active when connected to an external device. The user hears both input from the external source and environmental sounds.

BiMix cable - for connection of two TEMPO+ speech processors to one FM System. The microphones of both TEMPO+ processors remain active. The user hears both input from the external source and environmental sounds.

Ext cable - TEMPO+ microphone is deactivated when connected to an external device. The user hears input from an external device without environmental sounds.

Cables shown with a MED-EL order number are available through your clinic or local MED-EL representative. Phonak cables and the Phonak MicroLink CI S adapter can be ordered from your local Phonak distributor.

NOTE: These cables are for use with battery-powered equipment only and should never be used with equipment plugged into an electrical outlet.

Connection to the TEMPO+ Angled Battery Pack

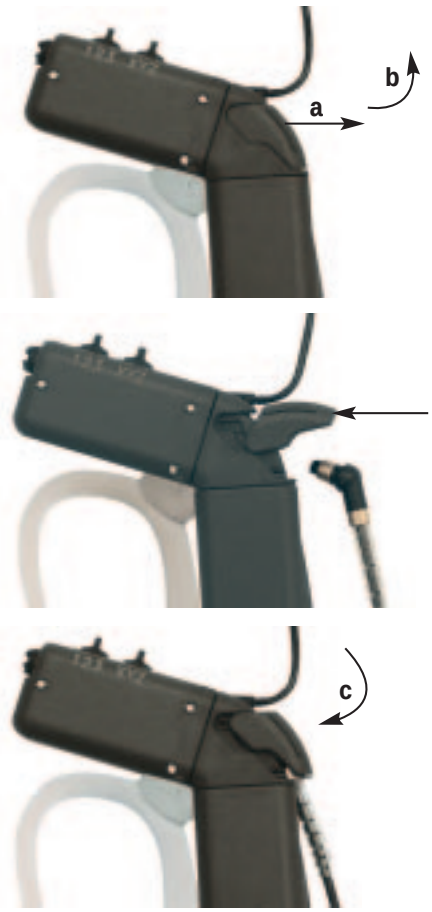
How to connect...

1. Open cover at the angled part of the device by pulling straight back **(a)** and lifting upward **(b)**.

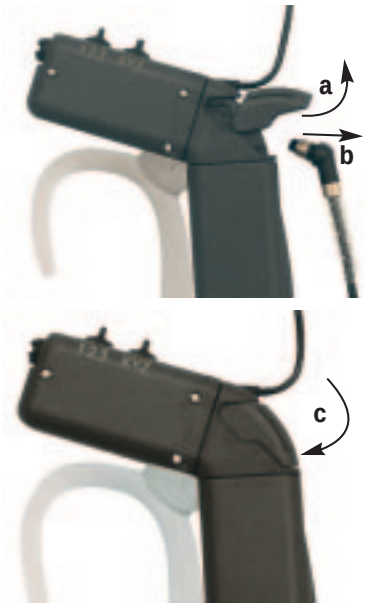
2. Insert the connector of the cable into the socket as shown. The red dot on the cable connector should be on top. When positioned correctly, the connector slides into the socket easily.

Note: Be careful not to force the connector into the socket in the wrong way.

3. Gently lower the cover until it rests on the connector **(c)**. This ensures maximum protection of the connector.



Connecting an FM Cable



Disconnecting an FM Cable

How to disconnect...

1. Lift up the cover **(a)**.

2. Remove cable by holding the connector and gently pulling it out **(b)**.

3. Close the cover by gently pushing it down and then inward until it rests into place **(c)**.

FM Adapter Cables for the TEMPO+ Remote Battery Pack

MED-EL offers a variety of adapter cables for use with FM systems, battery-operated devices such as portable CD players, and Assistive Listening Devices (ALDs).

FM Systems generally require adapter cables designed for each specific system. The following table provides a list of FM Systems and compatible adapter cables.

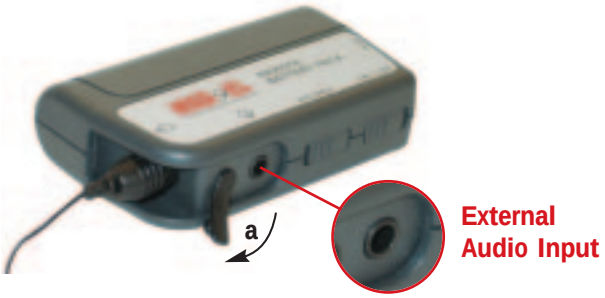
Manufacturer	Type	FM System Name	Adapter Cable	Order No.
Phonic Ear	Transmitter	Lexis		
Phonic Ear	Receiver	Lexis		
Phonak	Adapter	MicroLink CI S	White Cable	from Phonak
Phonic Ear	Transmitter & Receiver	Solaris	Solaris Adapter Cable (green ring, 3 pins)	01847
Phonak	Transmitter	Campus S		
Phonak	Receiver	MicroLink MLxS		
Phonak	Adapter	MicroLink CI S	Phonak White Cable	from Phonak
Phonak	Transmitter	Campus S		
Phonak	Receiver	MicroLink CI+	Phonak White Cable	from Phonak
Phonak	Transmitter	HandyMic		
Phonak	Receiver	MicroLink CI+	Phonak Gray Cable	from Phonak
Sennheiser	Transmitter	Mikroport 2013 PLL		
Phonak	Receiver	MicroLink CI+	Phonak White Cable	from Phonak
Phonak	Transmitter & Receiver	MicroVox Hxx COM I	Phonak Adapter Cable (3 pins)	01848
Sennheiser	Transmitter & Receiver	Mikroport 2015	RBP Sennheiser Cable (yellow ring)	02699
Sennheiser	Transmitter & Receiver	Mikroport 2013 PLL	RBP Sennheiser Cable (yellow ring)	02699
Research	Transmitter & Receiver	Vario 800	RBP Sennheiser Cable (yellow ring)	02699
Connevans	Transmitter & Receiver	CRM220	Connevans Adapter Cable (blue ring, 2 pins)	01621
Sonovation	Transmitter & Receiver	Logicom CI	RBP AVR Cable (green ring)	03175
Williams Sound	Transmitter & Receiver	Hearing Helper	RBP Sennheiser Cable (yellow ring)	02699
Comtek	Transmitter & Receiver	Comtek AT216	RBP Sennheiser Cable (yellow ring)	02699

Cables shown with a MED-EL order number are available through your clinic or local MED-EL representative. Phonak cables, and the Phonak MicroLink CI S adapter can be ordered from your local Phonak distributor.

NOTE: These cables are for use with battery-powered equipment only and should never be used with equipment plugged into an electrical outlet.

Connection to the TEMPO+ Remote Battery Pack

1. Remove the rubber protector of the audio input **(a)**



2. Ensure that the correct end of the adapter cable is used. The correct end features a colored ring **(b)**.

3. Insert the adapter cable into the socket **(c)**.

EXT/MIX Switch

The EXT/MIX switch is used to control microphone function when an external device is connected

EXT: TEMPO+ microphone deactivated
The user hears input from an external device only without environmental sounds.

MIX: TEMPO+ microphone active
The user hears input from the external device and environmental sounds.

PHONAK

BAT

Recommended FM systems and Settings

FM receivers and FM transmitters have various controls to adjust parameters such as microphone sensitivity, input mode, transmission channel, output volume, output mode, etc. In some cases, tools may be needed or the device housings may have to be opened for adjustments.

To reach optimal performance with an FM system, we recommend that you contact a hearing aid dealer for adjustment of the device.

MED-EL provides recommended FM system settings as a starting point for initial fitting. When the recommended settings include a range, we suggest starting in the middle of the range. Note that the channel selected on the receiver and transmitter must be always the same.

For all FM transmitters, the use of a separate lapel microphone is strongly recommended. It should be positioned at a distance of approximately 20 cm (8 in.) from the mouth of the speaker. Friction and wind noises should be avoided. The cable leading from the lapel microphone to the FM transmitter as well as the cable between the FM receiver and the TEMPO+ should hang freely.

There are numerous FM systems available for use with MED-EL cochlear implant systems. FM systems differ in transmission range, sound quality, size, availability of multiple channels, battery life and other features.

MED-EL recommends that you contact your local FM system distributor or hearing aid dealer when considering an FM system. You may be able to borrow a system for a week to test it in the specific conditions in which it will be used.

Please note that FM transmission frequences may also be subject to legal restrictions, which vary regionally. Make sure that all requirements are met and all local laws are conformed to.

The FM systems described in this guide have been tested by MED-EL and are recommended for use with the TEMPO+ speech processor. These systems have shown good sound quality and a transmission range of at least 10 m (30 ft.). However, the performance of any FM system will depend on many factors and the specific environment in which it is used.

Phonic Ear Lexis and MicroLink CI S Adapter

Description:

	Transmitter Lexis (1)	Receiver Lexis (2)	Adapter MicroLink CI S (3)
Dimensions	125 x 20 x 35 mm 4.9 x 0.78 x 1.37”	15,2 x 12,4 x 11,3 mm 0.59 x 0.48 x 0.44”	28 x 21 x 12 mm
Weight	75 g	2.1 g	11 g (without battery)
Operation time	8 h (rechargeable) 10 (disposable AAA)	– 100 – 5,500 Hz	100 h
Audio bandwidth	100 – 6,500 Hz	80 - 7,300 Hz	
Channels	15 (preprogrammed)	1 (fixed-14 to choose from)	

Connection:

Angled Battery Pack

Listening Mode selected by **cable**	MONAURAL		BINAURAL	
	Adapter Cable	*Order Number*	*Adapter Cable*	*Order Number*
MIX mode	Phonak Red Cable	can be ordered from Phonak	Phonak Red Red Cable	can be ordered from Phonak
EXT mode	Phonak Red Cable turn TEMPO+ AGC OFF!		Phonak Red Red Cable turn both TEMPO+ AGCs OFF!	

Remote Battery Pack

Listening Mode selected by **switch**	MONAURAL	
	Adapter Cable	*Order Number*
MIX mode	Phonak White Cable	can be ordered from Phonak
EXT mode		

Recommended settings:

	ANGLED BATTERY PACK	REMOTE BATTERY PACK	
		MIX mode	*EXT mode*
Transmitter Phonic Ear Lexis			
ON/OFF/mode switch	Omnidirectional	Omnidirectional	Omnidirectional
Receiver Phonic Ear Lexis			
Mode Switch	°° FM + HA	° FM	° FM
FM Gain Control	Max	Max	Max
Adapter MicroLink CI S			
Volume	2 .. 3	3	2

NOTE: A new CI adapter made by Phonic Ear will be available soon.

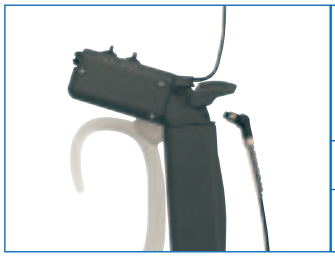
Phonic Ear Solaris PE 571T + PE 572R (or PE 575 R)

Description:

	Transmitter PE 571 T	Receiver PE 572 R
Dimensions	76 x 58 x 21 mm 3 x 2.3 x 0.83"	76 x 58 x 21 mm 3 x 2.3 x 0.83"
Weight	100 g / 3.5 oz	100 g / 3.5 oz
Operation time	10 h (rechargeable AA) 20 h (disposable AA)	10 h (rechargeable AA) 20 h (disposable AA)
Audio bandwidth	100 – 5,000 Hz	100 – 5,000 Hz
Channels	40 (country specific)	40 (country specific)

Connection:

Angled Battery Pack



Listening Mode selected by **cable**	MONAURAL		BINAURAL	
	Adapter Cable	*Order Number*	*Adapter Cable*	*Order Number*
MIX mode	T+ EuroMix	2379	T+ EuroBiMix	2707
EXT mode	T+ EuroMix turn TEMPO+ AGC OFF!	2379	T+ EuroBiMix turn both TEMPO+ AGCs OFF!	2707

Remote Battery Pack

Listening Mode selected by **switch**	MONAURAL	
	Adapter Cable	*Order Number*
MIX mode	Solaris Adapter Cable	1847
EXT mode		

Recommended settings:

	ANGLED BATTERY PACK	REMOTE BATTERY PACK	
		MIX mode	*EXT mode*
Transmitter PE 571 T			
ON/OFF switch	MIC/AUX	MIC/AUX	MIC/AUX
Receiver PE 572 R/ PE 575 R			
ON/OFF switch	FM	FM	FM
FM volume	4	6 .. 8	4 .. 8
Output mode	HI	DAI	DAI
FM plus	OFF	OFF	OFF
TMX	OFF	OFF	OFF
AUX switch	Any position	Any position	Any position

Receiver PE 572 R
PE 575 R

Transmitter PE 571T

Back of the Receiver

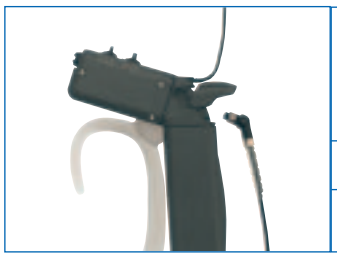
Campus S, Phonak MicroLink MLxS and MicroLink CI S Adapter

Description:

	Transmitter Campus S	Receiver MicroLink MLxS	Adapter MicroLink CI S
Dimensions	62 x 50 x 25 mm	13,5 x 10,9 x 14 mm	28 x 21 x 12 mm
Weight	75 g (incl. Battery)	1,8 - 2,1 g	11 g (without Battery)
Operation time	12 h (rechargeable)		100 h
Audio bandwidth	100 - 7,000 Hz	100 - 7,500Hz	80 - 7,300 Hz
Channels	40 (country specific)	multi channel	

Connection:

Angled Battery Pack



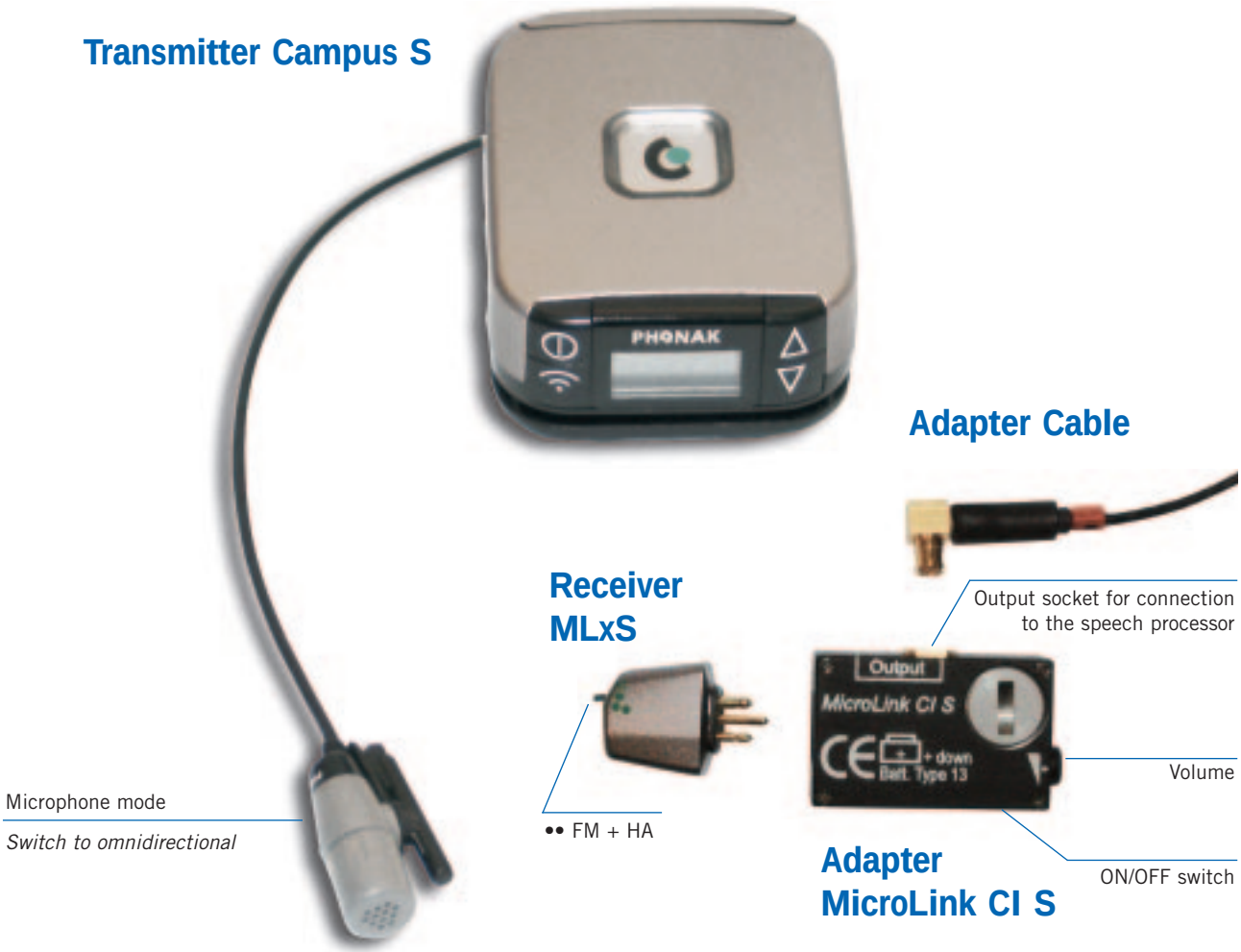
Listening Mode selected by **cable**	MONAURAL		BINAURAL	
	Adapter Cable	*Order Number*	*Adapter Cable*	*Order Number*
MIX mode	Phonak Red Cable	can be ordered from Phonak	Phonak Red Red Cable	can be ordered from Phonak
EXT mode	Phonak Red Cable turn TEMPO+ AGC OFF!		Phonak Red Red Cable turn both TEMPO+ AGCs OFF!	

Remote Battery Pack

Listening Mode selected by **switch**	MONAURAL	
	Adapter Cable	*Order Number*
MIX mode	Phonak White Cable	can be ordered from Phonak
EXT mode		

Recommended settings:

	ANGLED BATTERY PACK	REMOTE BATTERY PACK	
		MIX mode	*EXT mode*
Transmitter Campus S			
Microphone mode	Omnidirectional	Omnidirectional	Omnidirectional
Receiver MicroLink MLxS			
Mode Switch	•• FM + HA	•• FM + HA	•• FM + HA
Adapter MicroLink CI S			
Volume	2	2	1 1/2



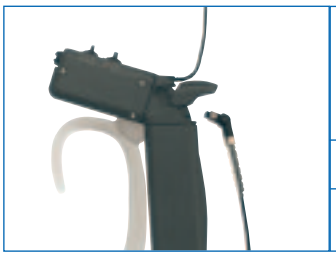
Campus S and Phonak MicroLink CI+

Description:

	Transmitter Campus S	Receiver MicroLink CI+
Dimensions	62 x 50 x 25 mm	44 x 21 x 12 mm
Weight	75 g (incl. Battery)	13 g (incl. Battery)
Operation time	12 h (rechargeable)	100 h (Zinc Air Type 13)
Audio bandwidth	100 - 7,000 Hz	50 - 7,500 Hz
Channels	40 (country specific)	1 (exchangeable oscillator)

Connection:

Angled Battery Pack



Listening Mode selected by **cable**	MONAURAL		BINAURAL	
	Adapter Cable	*Order Number*	*Adapter Cable*	*Order Number*
MIX mode	Phonak Red Cable	can be ordered from Phonak	Phonak Red Red Cable	can be ordered from Phonak
EXT mode	Phonak Red Cable turn TEMPO+ AGC OFF!		Phonak Red Red Cable turn both TEMPO+ AGCs OFF!	

Remote Battery Pack

Listening Mode selected by **switch**	MONAURAL	
	Adapter Cable	*Order Number*
MIX mode	Phonak White Cable	can be ordered from Phonak
EXT mode		

Recommended settings:

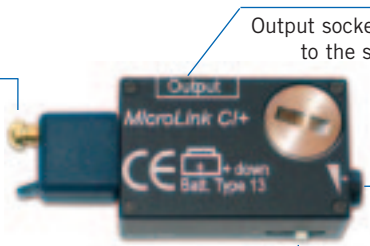
	ANGLED BATTERY PACK	REMOTE BATTERY PACK	
		MIX mode	*EXT mode*
Transmitter Campus S			
Microphone mode	Omnidirectional	Omnidirectional	Omnidirectional
Receiver MicroLink CI+			
Volume	3	2 1/2	2

Transmitter Campus S

Microphone mode

Switch to omnidirectional

Receiver MicroLink CI+



Output socket for connection to the speech processor

Antenna

Volume

ON/OFF switch

Tx3 HandyMic and Phonak MicroLink CI+

Description:

	Transmitter Tx3 HandyMic	Receiver MicroLink CI+
Dimensions	125 x 33 x 18 mm	44 x 21 x 12 mm
Weight	75 g (incl. Battery)	13 g (incl. Battery)
Operation time	13 h (rechargeable)	100 h (Zinc Air Type 13)
Audio bandwidth	100 - 7,000 Hz	50 - 7,500 Hz
Channels	1 (crystal controlled)	1 (exchangeable oscillator)

Connection:

Angled Battery Pack

Listening Mode selected by **cable**	MONAURAL		BINAURAL	
	Adapter Cable	*Order Number*	*Adapter Cable*	*Order Number*
MIX mode	Phonak Red Cable	can be ordered from Phonak	Phonak Red Red Cable	can be ordered from Phonak
EXT mode	Phonak Red Cable turn TEMPO+ AGC OFF!		Phonak Red Red Cable turn both TEMPO+ AGCs OFF!	

Remote Battery Pack

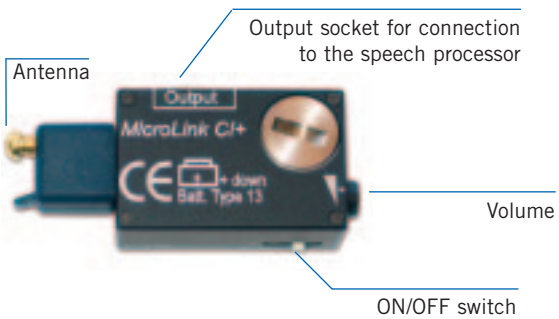
Listening Mode selected by **switch**	MONAURAL	
	Adapter Cable	*Order Number*
MIX mode	Phonak Gray Cable	can be ordered from Phonak
EXT mode		

Recommended settings:

	ANGLED BATTERY PACK	REMOTE BATTERY PACK	
		MIX mode	*EXT mode*
Transmitter HandyMic			
Microphone mode	Omnidirectional	Omnidirectional	Omnidirectional
Receiver MicroLink CI+			
Volume	3 .. 3 1/2	2	2

Transmitter Tx3 HandyMic

Receiver MicroLink CI+



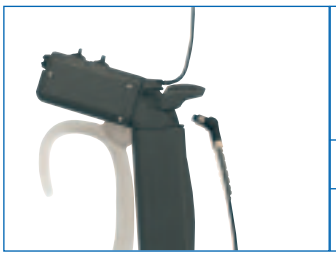
Phonak MicroVox H33 COM I

Description:

	Transmitter	Receiver
Dimensions	64 x 48 x 24 mm 2.5 x 1.8 x 0.9”	72 x 48 x 24 mm 2.8 x 1.8 x 0.9”
Weight	28 g (without battery)	44 g (without battery)
Operation time	20 h (rechargeable) 40 h (disposable AA)	120 h (rechargeable) 200 h (disposable AA)
Audio bandwidth	100 – 8,000 Hz	100 – 8,000 Hz
Channels	1 (crystal controlled)	1 (crystal controlled)

Connection:

Angled Battery Pack



Listening Mode selected by **cable**	MONAURAL		BINAURAL	
	Adapter Cable	*Order Number*	*Adapter Cable*	*Order Number*
MIX mode	T+ EuroMix	2379	T+ EuroBiMix	2707
EXT mode	T+ EuroMix turn TEMPO+ AGC OFF!	2379	T+ EuroBiMix turn both TEMPO+ AGCs OFF!	2707

Remote Battery Pack

Listening Mode selected by **switch**	MONAURAL	
	Adapter Cable	*Order Number*
MIX mode	Phonak Adapter Cable	1848
EXT mode		

Recommended settings:

	ANGLED BATTERY PACK	REMOTE BATTERY PACK	
		MIX mode	*EXT mode*
Transmitter			
ON/OFF switch	ON	ON	ON
Receiver			
FM volume	2 1/2..3	3 .. 5	3 .. 4 1/2
L/N switch	L or N	L or N	L or N

Description:

	Transmitter SK 2015	Receiver EK 2015
Dimensions	82 x 64 x 24 mm	82 x 64 x 24 mm
Weight	175 g (incl. batteries)	175 g (incl. batteries)
Operation time	12 h (rechargeable)	12 h (rechargeable)
Audio bandwidth	80 – 16,000 Hz	80 – 16,000 Hz
Channels	20	20

Connection:

Angled Battery Pack

Listening Mode selected by **cable**	MONAURAL		BINAURAL	
	Adapter Cable	*Order Number*	*Adapter Cable*	*Order Number*
MIX mode	T+ AudioMix	2377	T+ AudioBiMix	2383
EXT mode	T+ AudioMix turn TEMPO+ AGC OFF!	2377	T+ AudioBiMix turn both TEMPO+ AGCs OFF!	2383

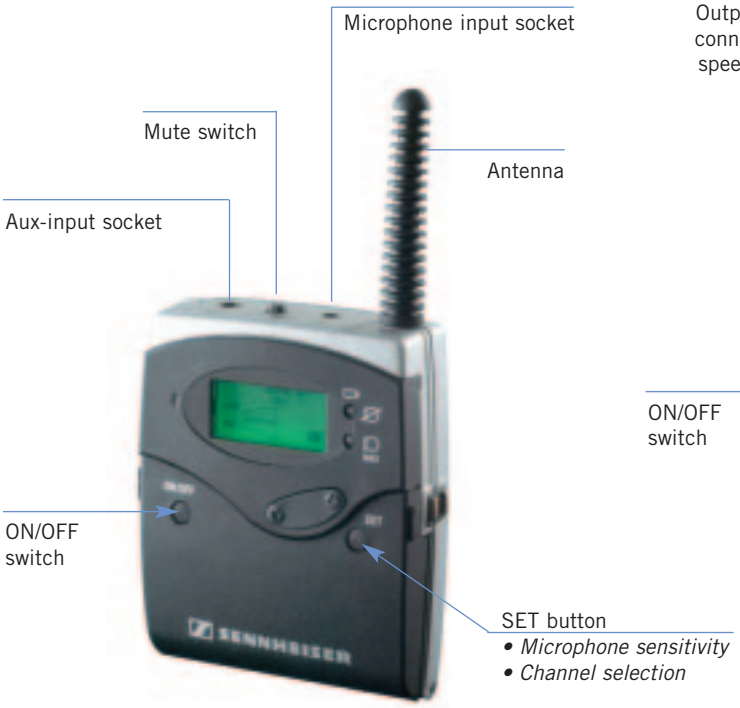
Remote Battery Pack

Listening Mode selected by **switch**	MONAURAL		BINAURAL	
	Adapter Cable	*Order Number*	*Adapter Cable*	*Order Number*
MIX mode	RBP Sennheiser Cable	2699	Binaural Audio Cable 33:1	2132
EXT mode	RBP Sennheiser Cable	2699	Binaural Audio Cable 33:1 with 2 Remote Battery Packs	2132

Recommended settings:

	ANGLED BATTERY PACK	REMOTE BATTERY PACK	
		MIX mode	*EXT mode*
Transmitter SK 2015			
ON/OFF switch	ON	ON	ON
Mute switch	OFF	OFF	OFF
Microphone mode	Omnidirectional	Omnidirectional	Omnidirectional
Microphone sensitivity	20	20	20
Receiver EK 2015			
ON/OFF switch	ON	ON	ON
FM volume	45	50	40
Internal microphone	OFF	OFF	OFF
Output socket	HI	HI	HI

Transmitter SK 2015



Receiver EK 2015

SENNHEISER mikroport 2013 PLL

Description:

	Transmitter SK 2013 PLL	Receiver EK 2013 PLL
Dimensions	95 x 57 x 17 mm	95 x 57 x 17 mm
Weight	132 g (incl. batteries)	134 g (incl. batteries)
Operation time	18 h (rechargeable) 50 h (2 disposable AA)	18 h (rechargeable) 50 h (2 disposable AA)
Audio bandwidth	40 – 16,000 Hz	40 – 16,000 Hz
Channels	16	16

Connection:

Angled Battery Pack

Listening Mode selected by **cable**	MONAURAL		BINAURAL	
	Adapter Cable	*Order Number*	*Adapter Cable*	*Order Number*
MIX mode	T+ AudioMix	2377	T+ AudioBiMix	2383
EXT mode	T+ AudioExt	2378	T+ AudioBiMix turn both TEMPO+ AGCs OFF!	2383

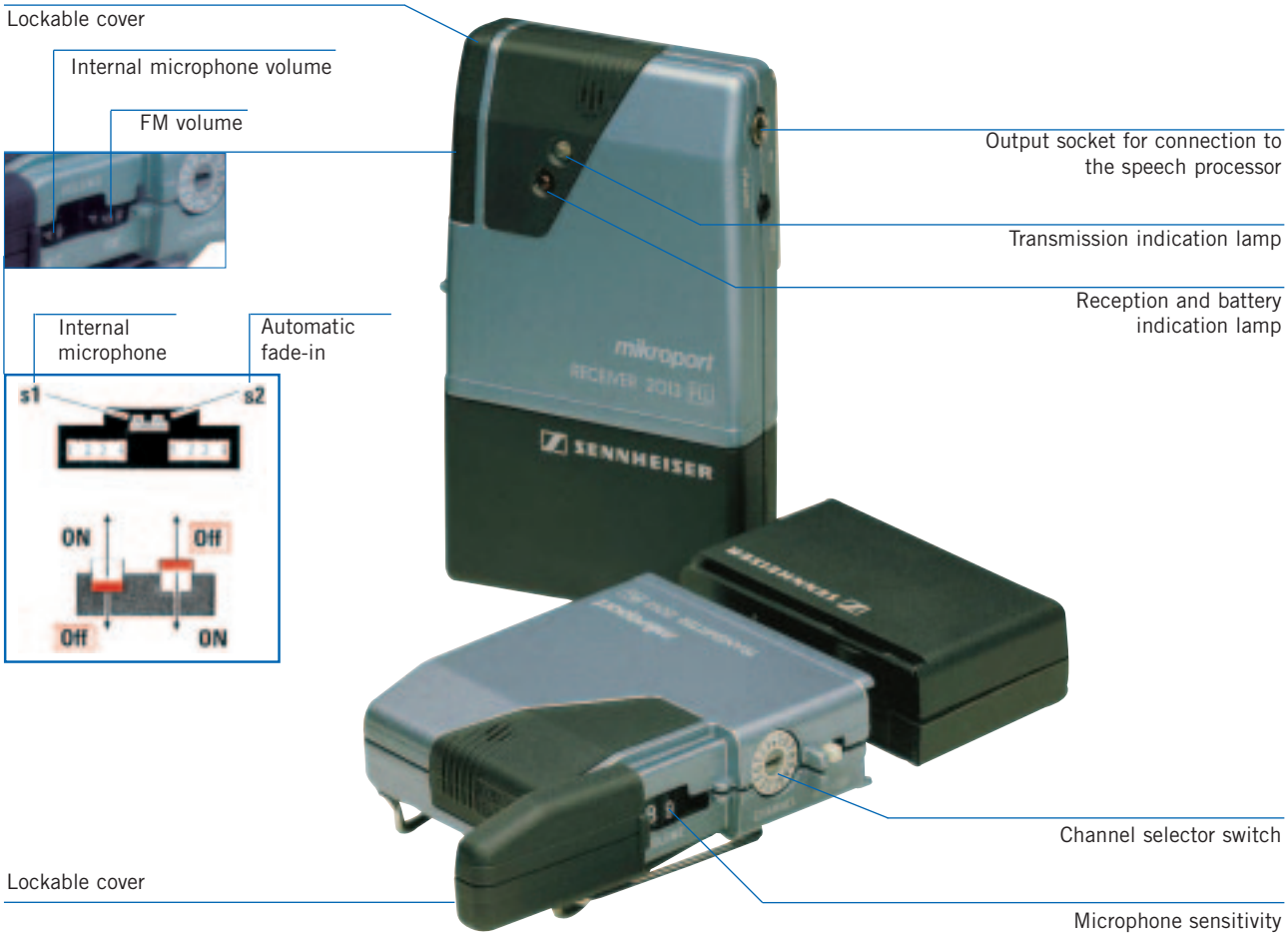
Remote Battery Pack

Listening Mode selected by **switch**	MONAURAL		BINAURAL	
	Adapter Cable	*Order Number*	*Adapter Cable*	*Order Number*
MIX mode	RBP Sennheiser Cable	2699	Binaural Audio Cable 33:1	2132
EXT mode	RBP Sennheiser Cable	2699	Binaural Audio Cable 33:1 with 2 Remote Battery Packs	2132

Recommended settings:

	ANGLED BATTERY PACK	REMOTE BATTERY PACK	
		MIX mode	*EXT mode*
Transmitter SK 2013			
Microphone sensitivity	8	7..8	7
Receiver EK 2013			
FM volume	3..4	5	3 1/2
Internal microphone	OFF	OFF	OFF
Automatic fade-in	OFF	OFF	OFF
Output socket	HI	HI	HI

Receiver



Transmitter

Research Vario 800

Description:

	Transmitter S 800/T	Receiver AE 800
Dimensions	80 x 60 x 21,5 mm	87,5 x 68 x 22,5 mm
Weight	160 g	150 g (with battery)
Operation time	3,5 h (rechargeable)	20 h (rechargeable)
Channels	16	16
Audio bandwidth	150 – 8,000 Hz	150 – 8,000 Hz

Connection:

Angled Battery Pack

Listening Mode selected by **cable**	MONAURAL		BINAURAL	
	Adapter Cable	*Order Number*	*Adapter Cable*	*Order Number*
MIX mode	Vario 800 Mix cable	3078	Vario 800 BiMix cable	3079
EXT mode	Vario 800 Mix cable turn TEMPO+ AGC OFF!	3078	Vario 800 BiMix cable turn both TEMPO+ AGCs OFF!	3079

Remote Battery Pack

Listening Mode selected by **switch**	MONAURAL			
	Adapter Cable	*Order Number*	*Alternative Adapter Cable*	*Order Number*
MIX mode	RBP Sennheiser Cable	2699**	Audio Adapter Cable 33:1	1547*
EXT mode				

* left and right audio signal will be mixed

** left and right audio signal will not be mixed; for monaural patients only left channel is used

Recommended settings:

	ANGLED BATTERY PACK	REMOTE BATTERY PACK	
		MIX mode	*EXT mode*
Transmitter S 800/T			
Level	HIGH	HIGH	HIGH
Receiver AE 800			
FM volume*	1/4 turn – 1/2 turn	1/2 turn	1/4 turn

* refers to one turn in relation to OFF position

Receiver AE 800

Transmitter S 800/T

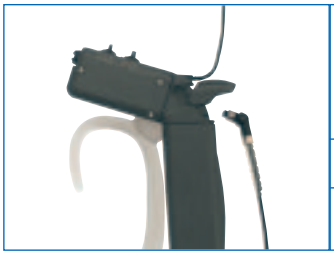
Connevans CRM 220 D

Description:

	Transmitter CRM T220	Receiver CRM R220
Dimensions	94 x 53 x 24 mm	94 x 53 x 24 mm
Weight	75 g (without battery)	80 g (without battery)
Operation time	40 h (rechargeable) 120 h (disposable)	40 h (rechargeable) 120 h (disposable)
Audio bandwidth	80 – 8,000 Hz	80 – 8,000 Hz
Channels	1	2 (with optimal plug-in)

Connection:

Angled Battery Pack



Listening Mode selected by **cable**	MONAURAL	
	Adapter Cable	***Order Number***
MIX mode	T+ ConnevansMix	2381
EXT mode	T+ ConnevansMix turn TEMPO+ AGC OFF!	2381

Remote Battery Pack

Listening Mode selected by **switch**	MONAURAL	
	Adapter Cable	***Order Number***
MIX mode	Connevans Adapter Cable	1621
EXT mode		

Recommended settings:

	ANGLED BATTERY PACK	REMOTE BATTERY PACK	
		MIX mode	*EXT mode*
Transmitter CRM T220			
ON/OFF switch	ON	ON	ON
Receiver CRM R220			
Switch	FM	FM	FM
Transmitter volume	→	→ .. ↑	→
Environmental volume	Minimum	Minimum	Minimum
Bass switch	Normal	OFF	OFF
Treble switch	Normal	OFF	OFF

Receiver CRM R220 **Transmitter CRM T220**

Sonovation Logicom Ci (Remote Battery Pack only)

Description:

	Transmitter TX-20	Receiver Logicom Ci
Dimensions	6.1"x1.22"x0.7" 155 x 31 x 18 mm	0.77"x0.77"x0.5" 22 x 22 x 15 mm
Weight	2.5 oz (72g)	0.35 oz (8g)
Operation time	6 h (rechargeable AA) 16 h (disposable AA)	70 h (size 13 Zinc Air)
Channels	200 – 8,000 Hz	200 – 8,000 Hz
Audio bandwidth	20	4 (quartz controlled)

Connection:

Remote Battery Pack

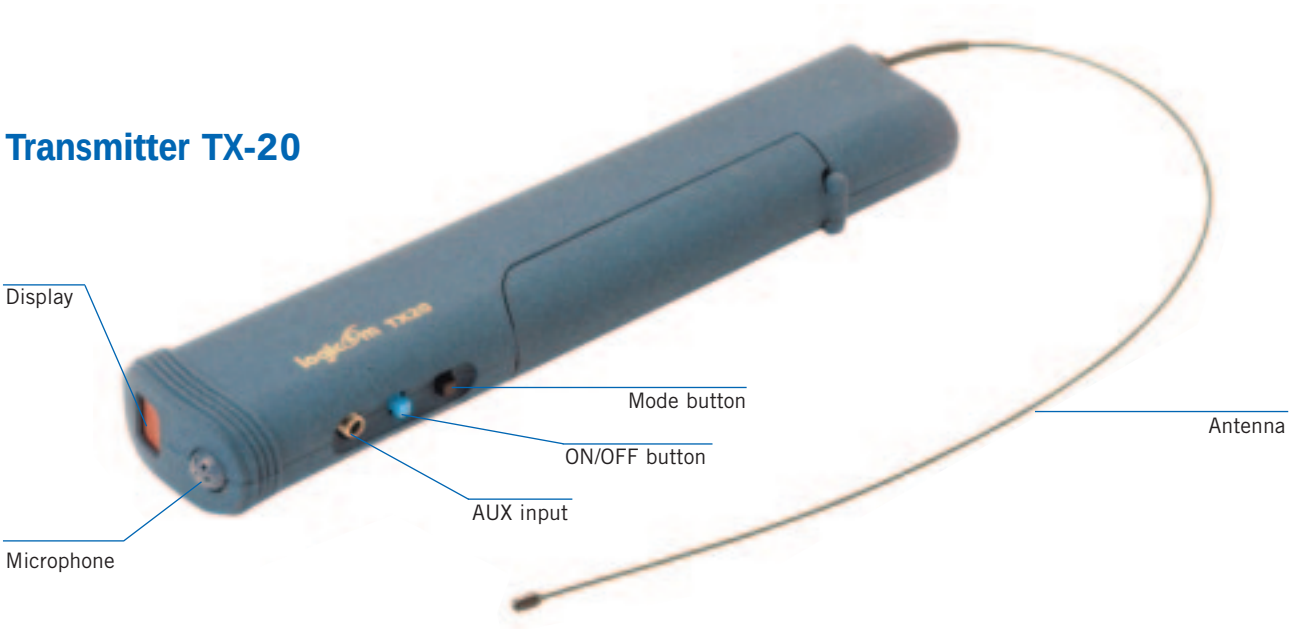
Listening Mode selected by **switch**	MONAURAL	
	Adapter Cable	*Order Number*
MIX mode *EXT mode*	RBP AVR Cable	3175

The Sonovation Logicom Ci is not compatible with TEMPO+ Angled Battery Pack interface, because the signal output is too little.

Recommended settings:

	REMOTE BATTERY PACK	
	EXT mode	*EXT mode*
Transmitter TX-20		
Gain	1	1
Receiver Logicom Ci		
Volume	Blue	Red - Blue

Transmitter TX-20



Receiver Logicom Ci

Williams Sound Hearing Helper PFM 350

Description:

	Transmitter PFM T30	Receiver PFM R31
Dimensions	3 5/8" x 2 3/8" x 7/8"	3 5/8" x 2 3/8" x 7/8"
	92.1 x 60.3 x 22.2 mm	92.1 x 60.3 x 22.2 mm
Weight	4.4 oz (125g) with batteries	4.6 oz (130g) with batteries
Operation time	10 h (2 rechargeable AA)	50 h (2 rechargeable AA)
	12 h (2 disposable AA)	80 h (2 disposable AA)
Audio bandwidth	100 – 10,000 Hz	100 – 10,000 Hz
Channels	10	2 (pre-set 72.9 and 75.7MHz)

Connection:

Angled Battery Pack

Listening Mode selected by **cable**	MONAURAL	
	Adapter Cable	*Order Number*
MIX mode	T+ AudioMix	2377
EXT mode	T+ AudioExt	2378

Remote Battery Pack

Listening Mode selected by **switch**	MONAURAL	
	Adapter Cable	*Order Number*
MIX mode	RBP Sennheiser Cable	2699
EXT mode		

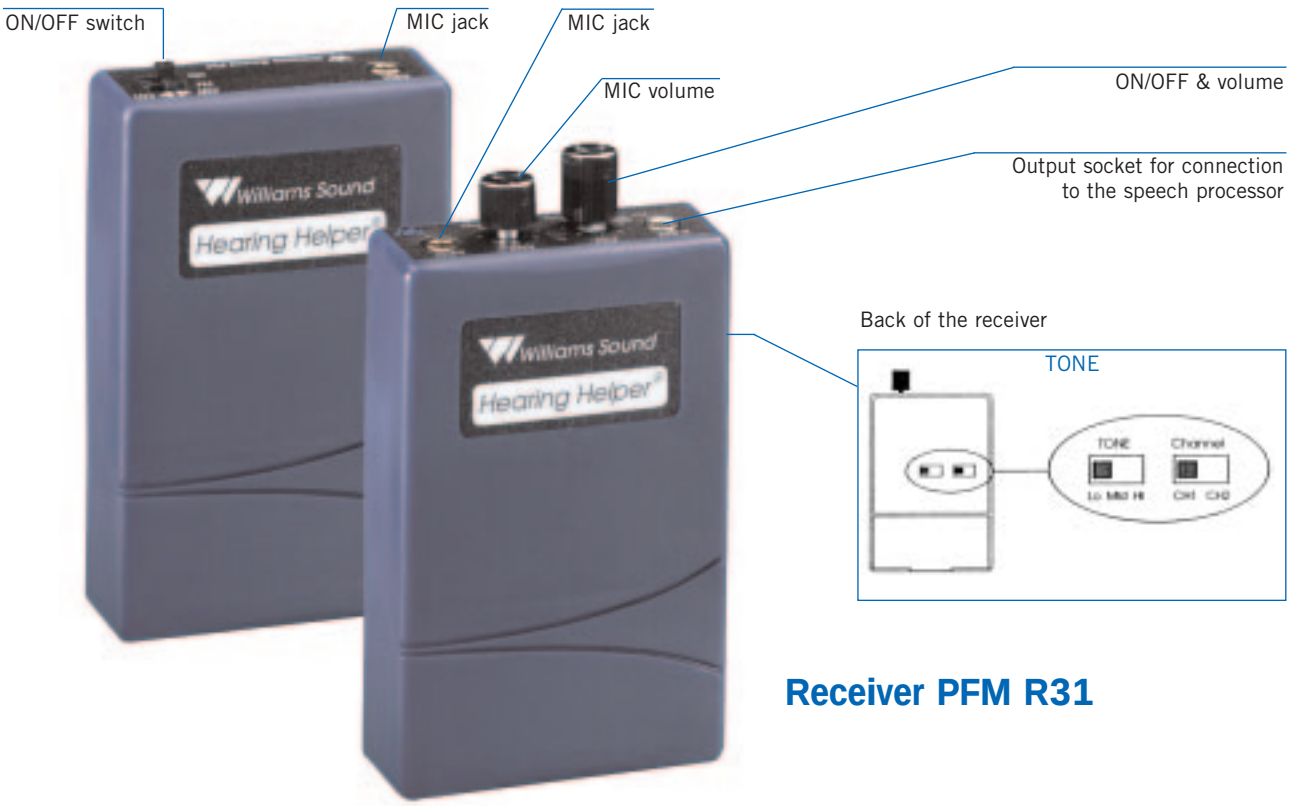
Recommended settings:

	ANGLED BATTERY PACK	REMOTE BATTERY PACK	
		MIX mode	*EXT mode*
Transmitter PFM T30			
ON/OFF switch	ON	ON	ON
Receiver PFM R31			
ON/OFF & FM volume	75%	75%	70%
MIC volume	MIN	MIN	MIN
Tone	Lo	Lo	Lo

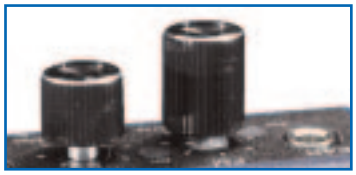
* refers to one turn in relation to OFF

The connected cables serve as antenna and must hang freely to get the best transmission quality.

Transmitter PFM T30



Receiver PFM R31



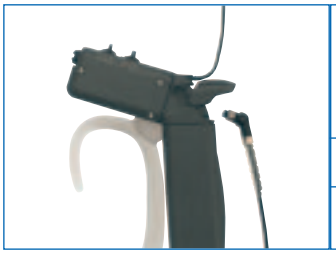
Comtek AT 216

Description:

	Transmitter M-216	Receiver MicroLink PR-216
Dimensions	83 x 57 x 27 mm 3 1/4 x 2 1/4 x 1 1/16"	83 x 57 x 27 mm 3 1/4 x 2 1/4 x 1 1/16"
Weight	4 oz / 110 g	4 oz / 110 g
Operation time	12 h (rechargeable) 40 h (9V alkaline)	10 h (rechargeable) 40 h (9V alkaline)
Audio bandwidth	80 – 10,000 Hz	80 – 12,000 Hz
Channels	57	57

Connection:

Angled Battery Pack



Listening Mode selected by **cable**	MONAURAL	
	Adapter Cable	***Order Number***
MIX mode	Comtek Mix Cable	3080
EXT mode	Comtek Mix Cable turn TEMPO+ AGC OFF!	3080

Remote Battery Pack

Listening Mode selected by **switch**	MONAURAL	
	Adapter Cable	***Order Number***
MIX mode	RBP Sennheiser Cable	2699
EXT mode		

Recommended settings:

	ANGLED BATTERY PACK	REMOTE BATTERY PACK	
		MIX mode	*EXT mode*
Transmitter M-216			
ON/OFF switch	ON	ON	ON
Voice gain	80%	80%	80%
Receiver PR-216			
ON/OFF switch	ON	ON	ON
Volume	85%	75%	60%

Troubleshooting

Once you are familiar with the TEMPO+ speech processor and your FM system, you will not find it difficult to handle minor technical problems which are similar to those encountered with other electronic devices. Malfunctions are most frequently related to batteries or cables. We recommend step by step troubleshooting of the FM system and the TEMPO+ speech processor.

Troubleshooting the TEMPO+ speech processor

Status Light

The TEMPO+ status light is the red indicator light on the front of the processor. Different blinking patterns indicate various malfunctions.

Speech Processor Test Device

The speech processor test device helps detect most common functional speech processor problems, such as defective coil cables or speech processor microphones, weak batteries or other minor problems.

To verify proper function of the TEMPO+ using the Speech Processor Test Device, proceed as follows:

Switch on the TEMPO+ and make sure that it has fresh batteries.

Place the coil underneath the Speech Processor Test Device. The coil will position itself correctly due to magnetic attraction.

When speaking into the microphone, the red light on the Speech Processor Test Device should flicker to the rhythm of your voice. If the red light does not light up or is on continuously, try the following steps:

- ✓ Adjust the setting of the volume control. By using the appropriate loudness setting, you should be able to recognize the flickering of the LED to the rhythm of your voice.
- ✓ Check the setting of the sensitivity control on the TEMPO+ (the sensitivity control should be set to 3 o'clock).
- ✓ Change the batteries.
- ✓ Replace the existing cable with a substitute cable.

If the Speech Processor Test Device indicates a system malfunction, contact your clinic or nearest MED-EL office. Do not try to open the TEMPO+ or to disassemble the coil as this will cause damage to the device and also voids any warranty.

Microphone Test Device

The Microphone Test Device is used to subjectively test the microphone of the TEMPO+. It is useful in families with young TEMPO+ users, in clinical settings and in schools. The amplified microphone signal can be heard by any hearing person using headphones to verify that sound is being received by the TEMPO+ microphone.

Please refer to the Microphone Test Device user manual for the corresponding test.

Troubleshooting an FM system

Similar to the speech processor, most functional problems with FM systems result from the use of improper or defective cables, bad connections, empty batteries or from distortion from other electronic devices.

To troubleshoot an FM system alone, please refer to the troubleshooting instructions in the respective user manual.

For a quick check of the FM system, follow these steps:

1. Check the adapter cable and all connections.
2. Make sure that the batteries are fully charged or use new batteries.
3. Check all settings on transmitter and receiver (according to recommendations provided in this guide).
4. Change to another transmission frequency.
5. Listen to the FM receiver with headphones.

Troubleshooting an FM system in combination with the TEMPO+ speech processor

After the correct function of each system is confirmed separately, the proper functioning of both systems in combination needs to be verified. To verify function, please follow these steps:

1. Connect both systems with the appropriate recommended adapter cable.
2. Turn both devices ON and adjust them using the suggested starting settings.
3. Turn the TEMPO+ microphone sensitivity to the OFF position (see page 11)
4. Place the coil underneath the Speech Processor Test Device.
5. When speaking into the microphone of the FM system, the red light on the Speech Processor Test Device should flicker to the rhythm of your voice. If the red light does not flicker or is on continuously replace the adapter cable with a substitute cable and repeat the last steps once again.

If this does not solve the problem, please contact your FM system supplier or local MED-EL representative for help.

References

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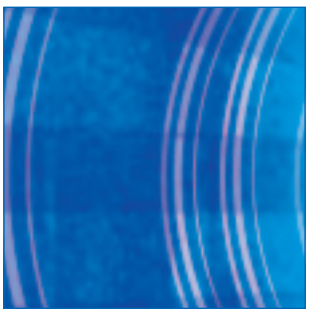
Moeller, MP et al (1996) Longitudinal study of FM system use in non-academic settings: effects on language development, Ear and Hear, 17: 28-41

Literature about the benefit of FM systems for children with hearing aids has been sufficiently discussed in Boothroyd & Inglehart 1998; Flexer, 1999, May, 1999; Nelson & Nelson, 1999, after Davies, Yellon, Purdy 2001 The Australian and New Zealand Journal of Audiology, Vol 23, Number 1 pp 52 – 62).

Contacting MED-EL

hearLIFE



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